

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
21 December 2006 (21.12.2006)

PCT

(10) International Publication Number  
**WO 2006/134345 A1**

(51) International Patent Classification:  
A61B 17/17 (2006.01)

(21) International Application Number:  
PCT/GB2006/002161

(22) International Filing Date: 13 June 2006 (13.06.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
0511847.6 13 June 2005 (13.06.2005) GB

(71) Applicant (for all designated States except US): **T. J. SMITH & NEPHEW LIMITED** [GB/GB]; 101 Hessle Road, Hull HU3 2BN (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **TURNER, Nick** [GB/GB]; Smith & Nephew Orthopaedics Ltd, 1 Kingmaker Court, Warwick Technology Park, Gallows Hill, Warwick CV34 6WG (GB). **O HARA, John** [GB/GB]; Smith & Nephew Orthopaedics Ltd, 1 Kingmaker Court,

Warwick Technology Park, Gallows Hill, Warwick CV34 6WG (GB).

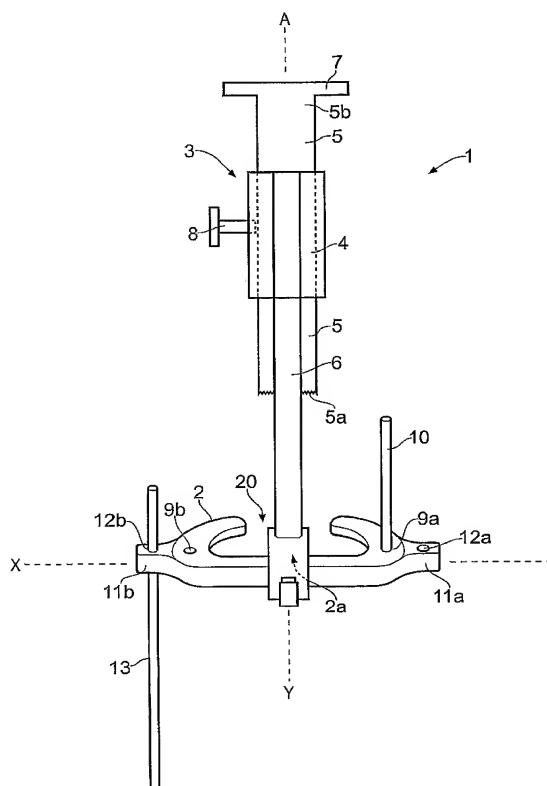
(74) Agent: **CONNORS, Martin**; Smith & Nephew Research Centre, York Science Park, Heslington, York YO10 5DF (GB).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,

[Continued on next page]

(54) Title: APPARATUS FOR LOCATING THE CENTRAL AXIS THROUGH THE FEMORAL HEAD AND NECK JUNCTION



(57) Abstract: An apparatus for locating the central axis through the femoral head and neck junction of a femur, comprising: a first component for at least partially receiving the femoral neck; a second component which cooperates with the first component so that the second component is aligned with the central axis, the second component being moveable between a first position in which it is disengaged from the femoral head, and a second position in which it is engaged with the femoral head; and a joining means for joining the first and second components. A method of using the apparatus to locate the central axis through the femoral head and neck junction of a femur is also provided.



FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT,  
RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA,  
GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the  
claims and to be republished in the event of receipt of  
amendments*

**Published:**

— *with international search report*

*For two-letter codes and other abbreviations, refer to the "Guid-  
ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.*

## APPARATUS FOR LOCATING THE CENTRAL AXIS THROUGH THE FEMORAL HEAD AND NECK JUNCTION

The present invention relates to a device for locating the central axis (centre line) through the femoral head and neck junction of a femur, together with a method for its use. In this application, the terms central axis, centre line and mid line have the same meaning.

When carrying out hip resurfacing surgery it is essential to accurately ream the femoral head to ensure correct positioning of the prosthetic femoral head component. To ensure correct reaming it is desirable to locate the central axis through the femoral head and neck junction. At present this is done during surgery largely by eye. There are in existence a variety of devices to assist in this process but most are designed to locate the centre of the femoral neck and not the centre line through the femoral neck and head junction.

An object of the present invention is to remove the necessity for the use of a lateral pin as a means of secondary fixation as with existing alignment devices, whilst reducing the incision size leading towards a Minimal Invasive Surgery (MIS) approach. It is also an aim to make the apparatus simple to use and to provide better accuracy and reproducibility.

According to a first aspect of the present invention there is provided an apparatus for locating the central axis through the femoral head and neck junction of a femur, comprising:

- a first component for at least partially receiving the femoral neck;

- a second component which cooperates with the first component so that the second component is aligned with the central axis, the second component being moveable between a first position in which it is disengaged from the femoral head, and a second position in which it is engaged with the femoral head; and

- a joining means for joining the first and second components.

Advantages of the present invention include that the apparatus is simple to use, with user interface and ergonomics of key

importance during its design. The apparatus makes femoral guide wire insertion simpler, with better accuracy and more reproducibility. It removes the use of a lateral or posterior targeting pin, whilst facilitating the use of a reduced incision.

According to a second aspect, the present invention provides an apparatus for use in locating the central axis through the femoral head and neck junction, the apparatus including a first component which comprises a partial ring shaped member lying in a first plane and a second component which comprises a plunger, wherein the first and second components are joined by a joining means, the plunger is positioned in a second plane substantially perpendicular to the first plane, wherein the plunger has a longitudinal axis extending therethrough which can be aligned to pass through the centre of the partial ring shaped member.

According to a third aspect of the present invention there is provided an apparatus for identifying the central axis through the femoral head and neck junction of a femur bone, the apparatus including a first component which comprises a partial ring shaped member lying in a first plane for at least partially receiving the femoral neck and a second component which comprises a plunger, wherein the first and second components are joined by a joining means.

The present invention references the mid line (central axis) of the neck as its datum rather than a measured distance down the lateral side of the femur. The present invention may make use of a neck ring (or horse shoes or partial ring shaped member) to centralise the femoral head whilst relating the alignment of the frame to the mid line of the femoral neck.

The neck rings or partial ring shaped members find and define the head/neck relationship to securely locate the femoral head central to its profile. It also provides from the outset a clear indication of the amount of bone material to be removed, and with the use of additional alignment rods greatly reduces the likelihood of

'femoral neck notching'. The neck ring or partial ring shaped member allows the surgeon to see from the outset the intended exit cut of the sleeve cutter, since the internal diameters of both the neck ring/partial ring shaped member and the sleeve cutter may be the same.

The plunger may be positioned in spaced relation with respect to partial ring shaped member to be in a second plane substantially perpendicular to the first plane.

The plunger defines an axis, which aligns with the central axis through the femoral head and neck junction of a femur bone.

The combination of the partial ring shaped member and the plunger allows the ring to be pulled into position resting on the underside of the ball component of the femur, i.e. the femoral head. This arrangement ensures that the partial ring shaped member references the head/neck junction of the femur, which is important in the location of the central axis (centre line) through the femoral head/neck junction.

Preferably the partial ring shaped member comprises more than half a complete ring, typically from two thirds to three quarters of a complete ring.

However, the partial ring shaped member may have a continuous or non-continuous structure to make up the partial ring shape.

The inner diameter of the partial ring member is likely to be the same or similar diameter as the femoral implant to be inserted.

The use of a partial ring shaped member allows the partial ring to be placed around the femoral neck. The femoral neck is generally oval in shape with the dimension from front to back being less than the dimension from side to side and therefore the opening in the partial ring shaped member can receive the femoral neck by means

of the smaller dimensional part of the neck passing through the opening. The partial ring shaped member as set out above references the head/neck junction when in the correct position. The partial ring can then be located in position relative to the frame of the device, by any known means for example by way of a spring ball plunger where it interfaces with the frame.

Preferably the plunger comprises a sleeve and a movable elongate component slidably received therein. The movable elongate component may be a rod. The sleeve is preferably tubular in nature, having a circular cross section and the rod is preferably cylindrical. There is preferably provided means to lock the movable component in position relative to the sleeve. For example the locking mechanism may be a screw-threaded bolt.

The movable elongate component is preferably provided with a channel extending along the longitudinal axis thereof and sized to receive a guide wire.

The joining means may be any suitable shape such as L shaped, U shaped or C shaped. The joining means preferably has a first end and a second end. The first end is preferably secured to the first component and the second end is preferably secured to the second component. Most preferably the first end is secured to the central point of the partial ring shaped member and the second is secured to a portion of the sleeve of the plunger.

The partial ring shaped member preferably has an inner and an outer edge. The inner edge preferably lies closest to the femoral neck when in use. Preferably the partial ring shaped member has a width of from 3 to 7mm from the inner to the outer edge, most preferably from 4 to 6mm. The partial ring shaped member preferably has a first and a second surface each extending between the inner and the outer edge. The partial ring shaped member preferably has a depth from its first to its second surface of from 2 to 5mm, preferably from 3 to 4mm. However, any width and/or

diameter suitable to align the partial ring shaped member could be used.

The partial ring shaped member is preferably provided with an aperture extending from its first to second surface and positioned 1 to 3mm, most preferably 2mm from the inner edge of the partial ring shaped member.

Preferably there are two apertures and one is positioned at each end of a diameter of the partial ring shaped member equidistant from the mid point of the partial ring shaped member. A first elongate rod may be positioned in the, either or both of the apertures. The first rod preferably has a length of from 20 to 40mm, preferably 30mm. The first rod preferably lies in the second plane.

The provision of the apertures and first rods allows the surgeon to ensure that bone is reamed off the femoral head. In use one of the rods is positioned to touch the femoral head when the apparatus (jig) is correctly positioned this ensures that the femoral head will be reamed correctly. Although the rod need not touch the bone, or indeed be used at all as the alignment can be achieved without these. However, the apertures and rods assist the alignment of the device with the central line through the head and neck junction of the femoral head.

The partial ring shaped member may also be provided with at least one shoulder extending therefrom, lying in the first plane and preferably positioned at an angle of 90° relative to the mid point of the partial ring shaped member. These shoulders may provide ideal positions for the apertures mentioned. Preferably there are provided two such shoulders, one positioned at each end of a diameter of the partial ring shaped member equidistant from the mid point of the partial ring shaped member. Preferably the or each shoulder is provided with an aperture extending therethrough.

A second elongate rod may be positioned in the, either or both of the apertures. The second rod preferably has a length of from 80

to 150mm, typically 120mm although any suitable length rod may be used. The second rod preferably lies in the second plane.

The provision of the shoulders having apertures and the elongate rods allows alignment with the centre line of the femoral neck from front to back to be considered and allowed for.

According to a fourth aspect of the present invention there is provided a method for locating the central axis through the femoral head and neck junction of a femur, the method comprising the steps of:

- providing a first component for at least partially receiving the femoral neck, the first component having a mid-point;

- providing a second component which cooperates with the first component so that the second component is aligned with the central axis, the second component being moveable between a first position in which it is disengaged from the femoral head, and a second position in which it is engaged with the femoral head;

- providing a joining means for joining the first and second components;

- at least partially receiving the femoral neck with the first component;

- moving the first component/second component/joining means apparatus until the mid-point of the first component is aligned generally parallel with the calcar; and

- engaging the second component with the femoral head until the first component is located against the femoral head and neck junction.

The first component may be passed anteriorly or posteriorly over the femoral neck.

The second component may be locked in place holding the first component against the femoral head and neck junction.

The first component may be a partial ring shaped member.

The second component may be a plunger.



The apparatus used may be provided with a first elongate rod positioned in an aperture in the first component on the lateral side of the apparatus and the position of the apparatus may be adjusted to ensure the rod is in contact with a part of the femoral head.

The apparatus used may be provided with a second elongate rod positioned in an aperture in the first component and the position of the apparatus may be adjusted to ensure the rod is aligned with the central axis of the femur in the anterior plane.

The second component may be provided with a channel extending along the longitudinal axis thereof and sized to receive a guide wire, and after the position of the central axis through the femoral head and neck junction has been determined a guide wire is inserted into the femoral head through the channel.

According to a fifth aspect the present invention provides a method for locating the central axis through the femoral head and neck junction, the method comprises:  
passing the opening in the partial ring shaped member of the apparatus of the second aspect of the invention over the femoral neck; twisting the apparatus until the mid point of the partial ring shaped member is aligned generally parallel with the calcar; and pressing the plunger against the femoral head until the partially ring shaped member is located against the femoral head/neck junction.

Preferably the partially ring shaped member is passed anteriorly or posteriorly over the femoral neck.

Preferably the plunger is locked in place holding the partially ring shaped member against the femoral head/neck junction.

Preferably the apparatus chosen is sized to match the femoral head/neck junction size of the patient. It is preferred that the diameter of the partially ring shaped member measured between the inner edges be generally the same as the diameter of the head/neck

junction. This ensures that the partially ring shaped member accurately references the head/neck junction.

Preferably the apparatus used is provided with a first elongate rod positioned in an aperture in the partial ring shaped member on the lateral side of the apparatus in use. The position of the apparatus is adjusted to ensure the rod is in contact with a part of the femoral head. This step ensures that bone is removed from the femoral head during reaming.

Preferably the apparatus used is provided with a second elongate rod positioned in an aperture in the shoulder in the partial ring shaped member on the medial side of the apparatus in use. The position of the apparatus is adjusted to ensure the rod is aligned with the centre line of the femur in the anterior plane.

Once the position of the central axis (centre line) through the femoral head/neck has been determined a guide wire is inserted into the femoral head through the channel in the elongate rod of the plunger.

Reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 shows an apparatus for use in locating the centre line through the femoral neck and head junction:

Figure 2 shows the application of the apparatus of Figure 1 to the femoral head and neck area of a bone.

Figure 3 shows the positioning of the apparatus of Figure 1 around the femoral head neck junction:

Figure 4 shows, from the rear, the use of an elongate rod to ensure alignment with the centre line of the femur:

Figure 5 is a view of the apparatus as in Figure 4 but from the inside of the femur:

Figure 6 shows in perspective and from the rear the apparatus of Figure 1 in position marking the centreline through the femoral head neck junction:

Figure 7 shows a second embodiment of the present invention in exploded view:

Figure 8 shows this second embodiment in fitted form:

Figure 9 shows a broken view of joining means in use with the second embodiment of the present invention:

Figure 10 shows another view of the joining means that joins the partial ring shaped member to the frame of the second embodiment of the present invention:

Figure 11 shows a top view of the plunger and partial ring shape of the second embodiment of the present invention:

Figure 12 shows the second embodiment of the present invention from a side view.

Figure 13 shows a third embodiment of the present invention from an isometric view.

The apparatus 1 for use in locating the centre line through the femoral head neck junction is shown in Figure 1 and has a partial ring shaped member 2 which lies in a first plane X. The partial ring shaped member is approximately three quarters of a complete ring in this example and has an open portion 20.

The apparatus 1 is also provided with a plunger 3 comprising a cylindrical sleeve 4 and a cylindrical rod 5 sized to be movable within the sleeve 4. The rod 5 has a longitude axis A passing therethrough

which lies in a second plane, perpendicular to the first plane, and passes through the centre of the partially ring shaped member.

The partial ring shaped member 2 and plunger 3 are joined together by means of a generally "L" shaped bar 6. The bar 6 lies in the second plane Y and meets the partial ring shaped member 2 at the mid point 2a of its circumference.

The partial ring shaped member 2 may be joined to the bar by a fixed or flexible means.

Typically, the partial ring shaped member 2 is joined to the bar 6 by means of a suitable joint that allows the partial ring shaped member 2 to move by up to for example 10° relative to the first plane. This joint moves a universal joint or any other joint that allows such movement. Being able to move slightly for example 5 or 10° relative to the first plane allows for anatomical geometry variations of the bone neck and still be able to align the device.

The bar 6 is formed integrally with the sleeve 4 of the plunger 3.

The rod 5 of the plunger 3 has a first end 5a and a second end 5b. The first end 5a is positioned closest to the partial ring shaped member 2 and is provided with a rough surface. The second end 5b is positioned furthest from the partial ring shaped member and is provided with a knob 7 sized to prevent the rod 5 from passing through the sleeve 4 and to allow easy movement of the rod 5.

The rod 5 can be locked in a given position relative to the sleeve 4. In a particular embodiment the sleeve 4 is provided with an aperture (not shown) therethrough and the aperture is provided with an internal screw thread. There is also provided a bolt 8 of a corresponding size and having an external screw thread. The bolt 8 can be screwed into the aperture and contacts the rod 5, therefore holding the rod 5 in a set position.

The rod 5 is provided with a channel (not shown) extending along its central longitude axis for receipt of a guide wire once the centre line through the femoral head/neck junction has been determined.

The partial ring shaped member 2 has a first surface and a second surface. The first surface lies closest to the plunger 3 and the second surface lies furthest from the plunger 3. The partial ring shaped member 2 is provided with two apertures 9a, 9b extending from the first surface to the second surface. The apertures 9a, 9b are positioned diametrically opposite each other and equidistant from the mid point 2a of the circumference of the partial ring shaped member 2. The apertures 9a, 9b each have an internal screw thread.

The apertures 9a, 9b are each sized to receive a first elongate bar 10 by means of a corresponding external screw thread.

Also provided on the partial ring shaped member 2 are shoulders 11a, 11b. The shoulders 11a, 11b are positioned diametrically opposite each other and equidistant from the mid point 2a of the circumference of the partial ring shaped member 2. The shoulders 11a, 11b each have an aperture 12a, 12b extending from the surface to the second surface.

The apertures 12a, 12b are each sized to receive a second elongate bar 13 by means of a push fit, or other means.

Figures 2 to 6 show the apparatus 1 of Figure 1 in use determining the centre line through the femoral head/neck junction. The figures are based on the left femur although in practice the invention can be used on other bones and regardless whether these are left or right.

Figure 2 shows how the apparatus 1 is initially located around the femoral neck 50. The opening 20 in the partial ring shaped member 2 is of suitable size to fit over the femoral neck 50 from the

medial side of the femur 51 as the femoral neck 50 is generally oval with the dimension from the front to the back of the neck being less than that from the inside to the outside.

Figure 3 shows the femur 51 from the posterior and also shows the apparatus 1 having been turned through approximately 90°, compared to Figure 2, so that the bar 6 is aligned with the calcar 52.

The plunger 3 is then activated by the rod 5 being moved through the sleeve 4 until the first end 5a of the rod 5 contacts the femoral head 53. The activation of the plunger 3 pulls the partial ring shaped member 2 into contact with the femoral head/neck junction 54. The ability of the partial ring shaped member 2 to move through 10° relative to the first plane X ensures good contact with the femoral head neck junction 54.

Once the partial ring shaped member 2 has achieved good contact with the femoral head neck joint the rod 5 of the plunger 3 can be locked in position against the femoral head to maintain the position of the apparatus relative to the femoral head neck junction 54. The rod 5 is locked in place within the sleeve 4 by means of the bolt 8 being tightened against the rod 5.

Figures 4 and 5 show the use of the elongate rod 13 to ensure alignment with the centre line of the femur itself in the anterior-posterior plane. The alignment rod may be used in the aperture in the shoulder on the medial side of the apparatus when in use. Therefore the rod 13 may be inserted into the aperture 12a in the shoulder 11a by means of push fit engagement until it touches the femur.

Generally the alignment rod 13 should be aligned with the centre line of the femur in the anterior-posterior plane by good contact being achieved between the partial ring shaped member and the femoral head/neck junction however if there is any misalignment this can be corrected by reference to the alignment rod 13.

Once the central axis (centre line) through the femoral head/neck junction has been determined by the preceding steps it is necessary to consider the reaming of bone from the femoral head to create a surface, which can receive a prosthetic head component. The central axis through the femoral head/neck junctions forms the centre for the reaming operation.

The internal diameter of the prosthetic head component will be the same as the final reaming head and both of these are sized to be the same as the diameter of the femoral head neck junction. The inner diameter of the partial ring shaped member 2 is the same as that of the femoral head/neck junction and is therefore the same as the chosen prosthetic femoral head and the related final reaming head.

This relationship of the diameter of the partial ring shaped member, the femoral head/neck junction and the associated prosthetic components is essential in the accurate reaming of the femoral head.

Accordingly once the central axis through the femoral head/neck junction has been determined it is necessary to check that reaming the head using this central axis will give rise to bone being removed from all areas of the head even that likely to be most worn or deformed.

The apparatus of the present invention may therefore be provided with a short rod 10, which is inserted into an aperture 9a, 9b in the partial ring shaped member 2 by for example means of screw threads. The rod is used on the side of the apparatus positioned on the lateral side of the femur as this is the area most prone to wear and deformity. Again once this rod is in position it may be necessary to slightly adjust the position of the apparatus so that there is proper alignment.

Once the final position of the apparatus has been set it may be locked in position and a guide wire can be inserted through the

centre of the rod 5 of the plunger 3 into the femoral head. The guide wire travels along the central longitudinal axis of the rod 5 and sets the central axis through the femoral head/neck junction 54 about which reaming of the femoral head and fitting of a prosthetic component can take place.

The femoral head is then reamed using the guide wire as the centre for the reaming operation. The size of head is reduced as the head is reamed until a head having the same diameter as the inner diameter as the partial ring shaped member is used. The femoral head should then be ready for a prosthetic component to be fitted again having the same internal diameter as the partial ring shaped member 2.

Figures 7 to 12 show a second embodiment of the present invention. As in the apparatus (1) shown in Figure 1, the apparatus (200) shown in Figures 7 to 12 has a partial ring shaped member (207) and a plunger (202) that are joined together by means of a generally "L" shaped bar (201). The apparatus can accommodate elongate rods (204, 206). The apparatus is provided with a locking means in the form of bolt (203) which can lock the plunger rod (202) in a set position.

Figure 13 shows a third embodiment of the present invention. As in the apparatus (1, 200) shown in Figures 1 and 7 to 12, the apparatus (301) shown in Figure 13 has a partial ring shaped member (302) and a plunger (303) that are joined together by means of a generally "L" shaped bar (306). The apparatus is provided with a locking means in the form of bolt (308) which can lock the plunger rod (305) in a set position.

The apparatus in Figure 13 can accommodate an elongate rod (310), as in the apparatus in Figure 1 discussed previously. In addition, the apparatus in Figure 13 has a closed channel/conduit (321) attached to the joining bar (306). The channel (321) extends along the longitudinal axis of the bar (306) and is sized to receive an elongate rod (322). This arrangement enables the surgeon to line up the long axis of the



bar (306) with the medial calcar. The longer elongate rod (322) provides an alignment tool which gives the surgeon a longer indication of the path that the guide wire will take when inserted.

Figure 13 also shows a projection (323) attached to the sleeve (304) of the plunger (303). This feature can also be seen in Figures 7, 8 and 12, but is not shown in Figure 1. In combination with the part (324) of the bar (306) that attaches to the sleeve (304), the projection (323) provides the surgeon with gripping points for his fingers so that he can hold the apparatus (301) in one hand and depress the plunger rod (305) with his thumb, similar to the operation of a syringe. This has the advantage that it is simple to use (one-handed operation) and optimised in terms of ergonomics.

The invention shall be further described by way of example by referring to the second embodiment of the invention and the drawings (mainly Figures 7 to 11) and following comments.

#### Apparatus Design Rational

The principle of this apparatus is that it allows the surgeon to see from the outset, the exit circle of the sleeve cutter. This also represents the position of the lower edge of the sleeve ring or napkin ring position at the head/neck junction. It allows the surgeon when he first applies the apparatus to the bone to predictably achieve the correct exit position of the sleeve cutter.

The apparatus (200) consists of a series of inter-changeable open rings (207) or horse shoes or partial ring shaped members as shown in Figure 7, which can be applied to the side arm/bottom (201) of the side of the apparatus body. The apparatus body (201), as shown in Figure 7, maintains a constant relationship between the axis of the guide wire and the centre of the circle, which represents the ring cutter exit position. The body of the instrument is L shaped and at its upper outer end, there is a sleeve, which bears a constant relationship to the centre of the horseshoe ring or partial ring shaped member (207). This sleeve, which has sharp teeth at the end away from the surgeon can be snugged down upon the

femoral head in order to obtain a secure position and can be held there by tightening up the securing finger grip.

#### Application of the Apparatus

The apparatus is applied to the femur as follows, with the apparatus assembled for the appropriate head size introduced.

With the hip dislocated and the head produced into the wound – usually in 0 or 30 ° of flexion and well over 100° of internal rotation of the femur, the apparatus assembly is applied to the femur. The side arm of the apparatus and the open side of the horseshoe ring or partial ring shaped member (207) is applied to the neck of the femur from the medial side so that horseshoe ring (207) is applied to the neck of the femur at its thinnest side. Once the deepest part of the horseshoe has touched the medial side of the neck and the head/neck junction, the apparatus is turned through 90°, clockwise for a left hip and anticlockwise for a right hip. As the opened section of the ring is positioned next to the thicker part of the femur neck on this rotation the ring is not able to slide out/off of the femur neck. This causes the arm (201) of the apparatus to face upwards. The upper most part of the inside of the horseshoe or partial ring shaped member (207) is now allowed to rest on the posterior aspect of the head/junction. It must not be allowed to ride away from this bone. The apparatus is now pulled towards the surgeon and the plunger pushed down on the femoral head.

#### Adjusting the alignment of the Apparatus

A long alignment rod is introduced through the longer unthreaded alignment hole on the medial aspect of the femoral head. This is now pushed down so that the tip of this rod touches the mid-point of the inner aspect of the femoral neck, usually at the lower margin of the lesser trochanter. This rod dictates the anterior-posterior positioning of the tip of the femoral component stem. This must contact the mid point in the anterior-posterior plane of the femur where it touches it.

If the surgeon wants to at this point, it is possible to pass a 3mm guide wire through the lateral long guide pin hole in the apparatus to hold the position of the ring at this point.

#### Varus Valgus alignment

The surgeon must now verify varus valgus alignment by looking along the long axis of the apparatus side arm and considering the relationship between the distal 2cms of the arm below the pivot point of the horseshoe and the medial aspect of the calcar between the head/neck junction and the lesser trochanter. The surgeon will usually have a view of 2cms of bone at this point and the distal part of the side arm should be parallel to this when used from above. This gives the ideal Varus Valgus alignment, with the stem of the femoral component parallel to the calcar at this point.

If the surgeon wants to, a 3mm guide wire can then be passed through the lateral guide hole on the ring in order to stabilise the ring in this alignment.

As shown in Figure 13, a longer alignment rod (322) may be passed through the aligning guide channel (321) and extended over the femur for additional alignment guidance.

#### Varus Valgas alignment

It is now desirable to check the Varus Valgus alignment. This is done by looking at the apparatus from above and after loosening off the plunger slightly adjusting it in Varus Valgus as required to get the distal most 2cm of the side arm of the apparatus which is now behind the femoral neck to be parallel to the 2cms of calcar visible between the underside of the horseshoe and the lesser trochanter.

The surgeon may wish then to verify both alignments once more before finally securing the plunger up against the femoral head under a little compression. The guide wire can now be introduced down the middle of the plunger.

### Pistol Grip Deformity

In patients who have pistol grip deformities the surgeon may be concerned that there is a risk that the cylindrical reamer may not remove any bone or cartilage on the lateral side of the femoral head – on the other hand it is necessary to just shave off the original peri-articular cartilage as a component will not be secure on un-reamed bone. To assist the surgeon in verifying that there is not a danger of performing “air shot” it is possible in these circumstances to introduce a short threaded rod into the small inner threaded hole on the lateral aspect of the horseshoe. This hole is 2mm in from the inner radius of the horseshoe and if the surgeon ensures that this touches the lateral aspect of the femoral head he will be guaranteed to avoid an “air-shot” and to remove the necessary amount of articular cartilage from this area to give best seating position for the femoral component.

### Verification of the position of the Guide Wire

Once the medial alignment rod has been removed from the horseshoe and the stabilising guide wire (if inserted) is removed from the greater trochanter, the whole apparatus can be revolved around femoral head on the guide wire verifying the position.

Note that this maybe somewhat restricted in patients where minimal access is being used and note also that on the front of the femoral neck many patients have osteophytes, which may impair free rotation of the apparatus or cause the guidewire to deflect slightly. This does not mean that the apparatus is incorrectly positioned if this happens.

### Dis-assembly of the Apparatus

To remove the apparatus first the plunger must be freed and removed from its sleeve. The apparatus must be turned through 90° to its original position of introduction to the medial side of the femoral neck and it is angulated sideways slightly and once the ring is dis-engaged from the neck and head it can be withdrawn completely off the guide wire. The position of the guide wire can then be verified using the conventional stylus system.

## CLAIMS

1. An apparatus for locating the central axis through the femoral head and neck junction of a femur, comprising:
  - a first component for at least partially receiving the femoral neck;
  - a second component which cooperates with the first component so that the second component is aligned with the central axis, the second component being moveable between a first position in which it is disengaged from the femoral head, and a second position in which it is engaged with the femoral head; and
  - a joining means for joining the first and second components.
2. An apparatus according to claim 1, wherein the first component is a partial ring shaped member.
3. An apparatus according to claim 2, wherein the partial ring shaped member comprises more than half a complete ring.
4. An apparatus according to claim 3, wherein the partial ring shaped member is between two-thirds to three-quarters of a complete ring.
5. An apparatus according to any of claims 2 to 4, wherein the inner diameter of the partial ring shaped member is the same or similar to the diameter of a femoral implant to be inserted.
6. An apparatus according to any preceding claim, wherein the first component is disposed in a first plane and the second component is disposed in a second plane substantially perpendicular to the first plane.
7. An apparatus according to any preceding claim, wherein the second component is a plunger.

8. An apparatus according to claim 7, wherein the plunger defines an axis which aligns with the central axis through the femoral head and neck junction of a femur.
9. An apparatus according to claim 7 or 8, wherein the plunger comprises a sleeve and a moveable component received therein.
10. An apparatus according to claim 9, wherein the moveable component is an elongate rod slidably received in the sleeve.
11. An apparatus according to claim 9 or 10, wherein the sleeve is tubular.
12. An apparatus according to claim 10 or 11, wherein the rod is cylindrical.
13. An apparatus according to any of claims 9 to 12, wherein the plunger comprises means to lock the moveable component in position relative to the sleeve.
14. An apparatus according to claim 13, wherein the locking means is a screw threaded bolt.
15. An apparatus according to any preceding claim, wherein the second component is provided with a channel extending along the longitudinal axis thereof and sized to receive a guide wire.
16. An apparatus according to any preceding claim, wherein the joining means is L-shaped, U-shaped or C-shaped.
17. An apparatus according to any preceding claim, wherein the partial ring shaped member has at least one aperture.
18. An apparatus according to claim 17, wherein the partial ring shaped member has two apertures.

19. An apparatus according to any preceding claim, wherein the joining means has at least one aperture.
20. An apparatus according to any of claims 17 to 19, wherein, in use, the or each aperture receives an elongate rod.
21. An apparatus according to any preceding claim, wherein the joining means has a channel extending along the longitudinal axis thereof and sized to receive an elongate rod.
22. A method for locating the central axis through the femoral head and neck junction of a femur, the method comprising the steps of:  
providing a first component for at least partially receiving the femoral neck, the first component having a mid-point;  
providing a second component which cooperates with the first component so that the second component is aligned with the central axis, the second component being moveable between a first position in which it is disengaged from the femoral head, and a second position in which it is engaged with the femoral head;  
providing a joining means for joining the first and second components;  
at least partially receiving the femoral neck with the first component;  
moving the first component/second component/joining means apparatus until the mid-point of the first component is aligned generally parallel with the calcar; and  
engaging the second component with the femoral head until the first component is located against the femoral head and neck junction.
23. A method according to claim 22, wherein the first component is passed anteriorly or posteriorly over the femoral neck.
24. A method according to claim 22 or 23, wherein the second component is locked in place holding the first component against the femoral head and neck junction.
25. A method according to any of claims 22 to 24, wherein the first component is a partial ring shaped member.

26. A method according to any of claims 22 to 25, wherein the second component is a plunger.

27. A method according to any of claims 22 to 26, wherein the apparatus used is provided with a first elongate rod positioned in an aperture in the first component on the lateral side of the apparatus and the position of the apparatus is adjusted to ensure the rod is in contact with a part of the femoral head.

28. A method according to claim 27, wherein the apparatus used is provided with a second elongate rod positioned in an aperture in the first component and the position of the apparatus is adjusted to ensure the rod is aligned with the central axis of the femur in the anterior plane.

29. A method according to any of claims 22 to 28, wherein the second component is provided with a channel extending along the longitudinal axis thereof and sized to receive a guide wire, and wherein after the position of the central axis through the femoral head and neck junction has been determined a guide wire is inserted into the femoral head through the channel.

30. An apparatus substantially as hereinbefore described with reference to the drawings.

31. A method substantially as hereinbefore described with reference to the drawings.



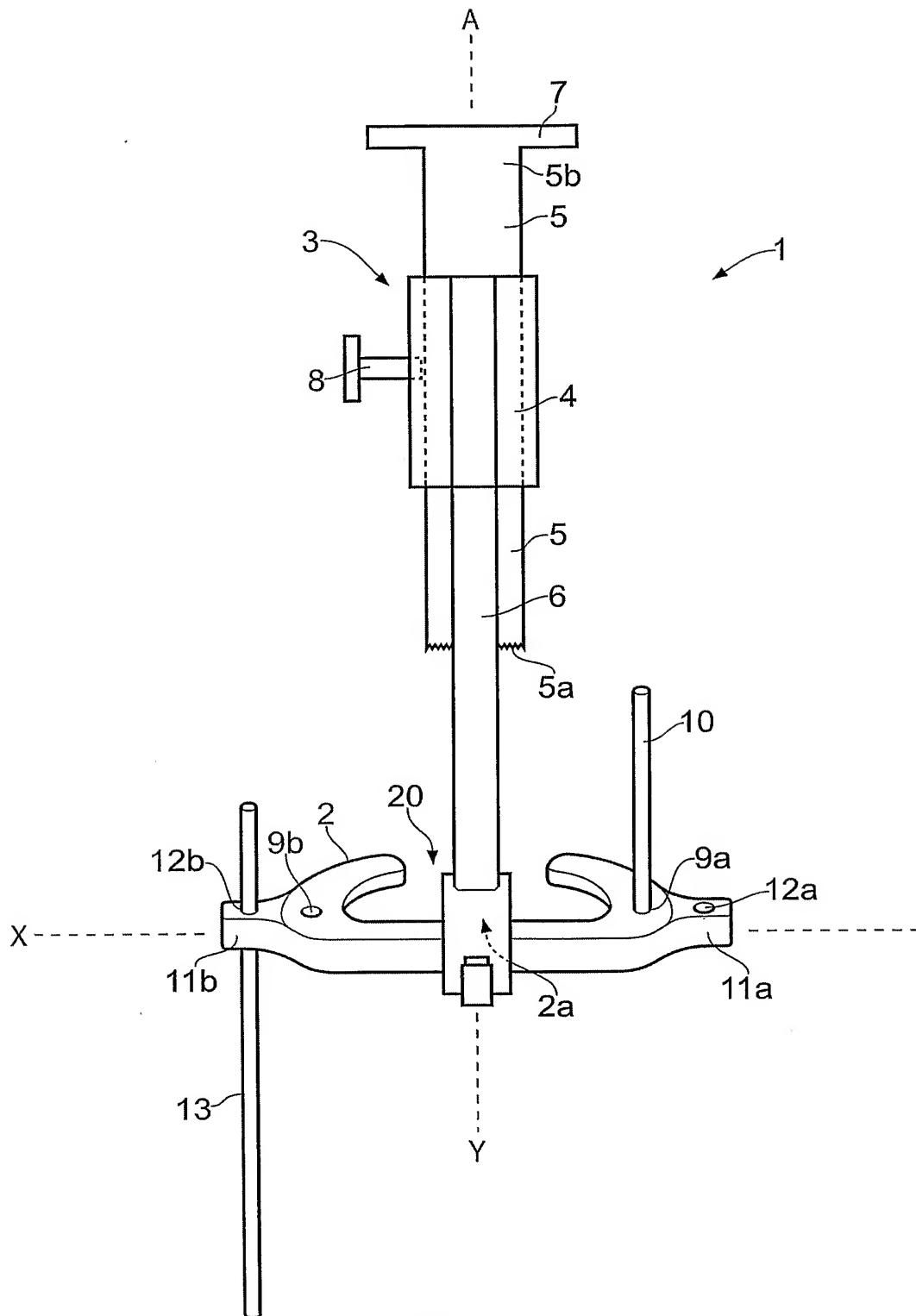


Fig. 1

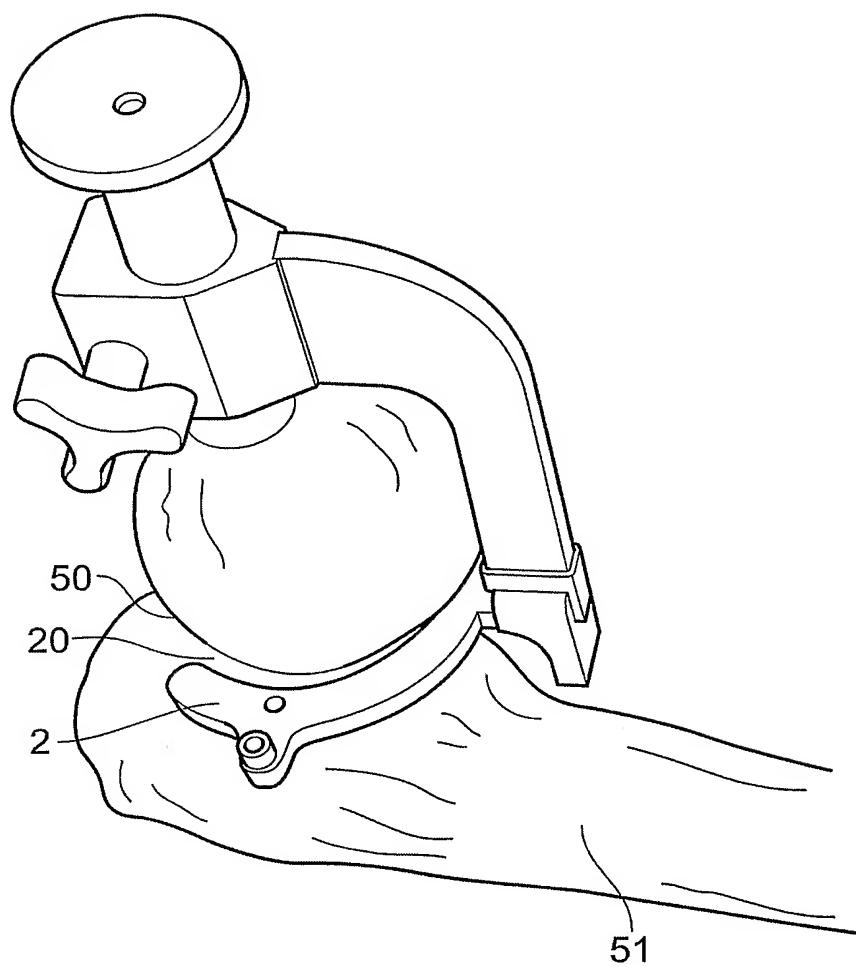


Fig. 2

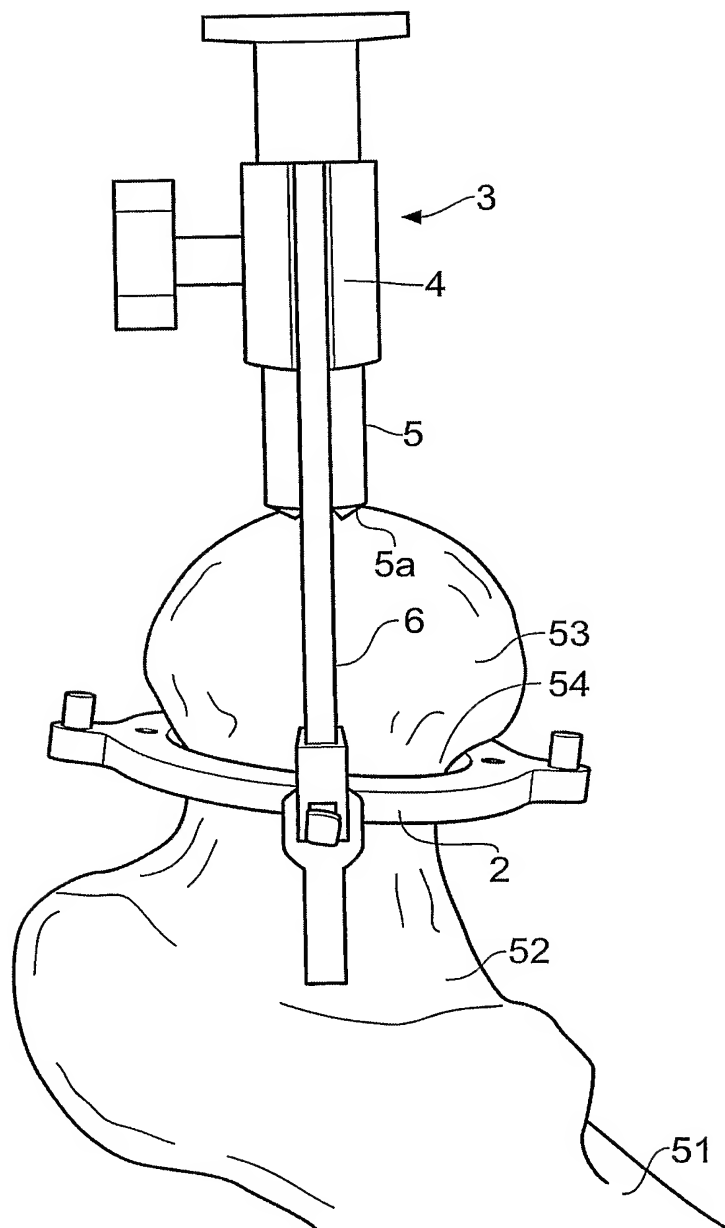


Fig. 3

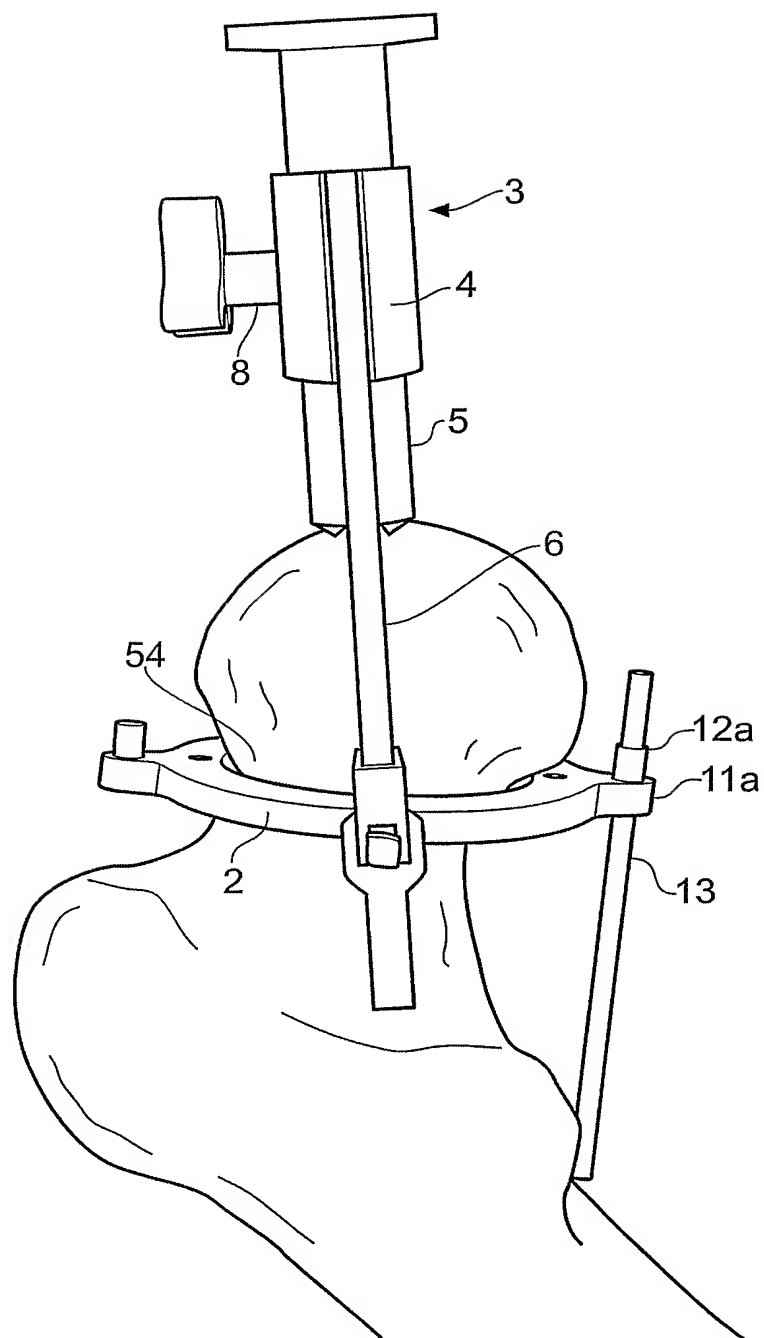


Fig. 4

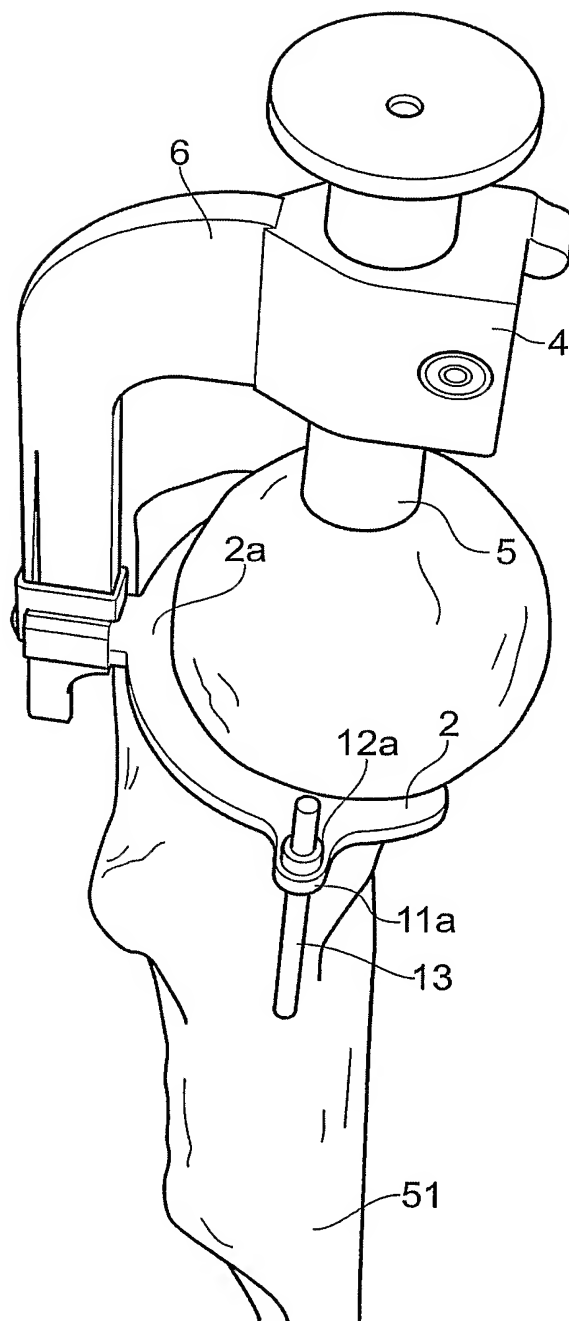


Fig. 5

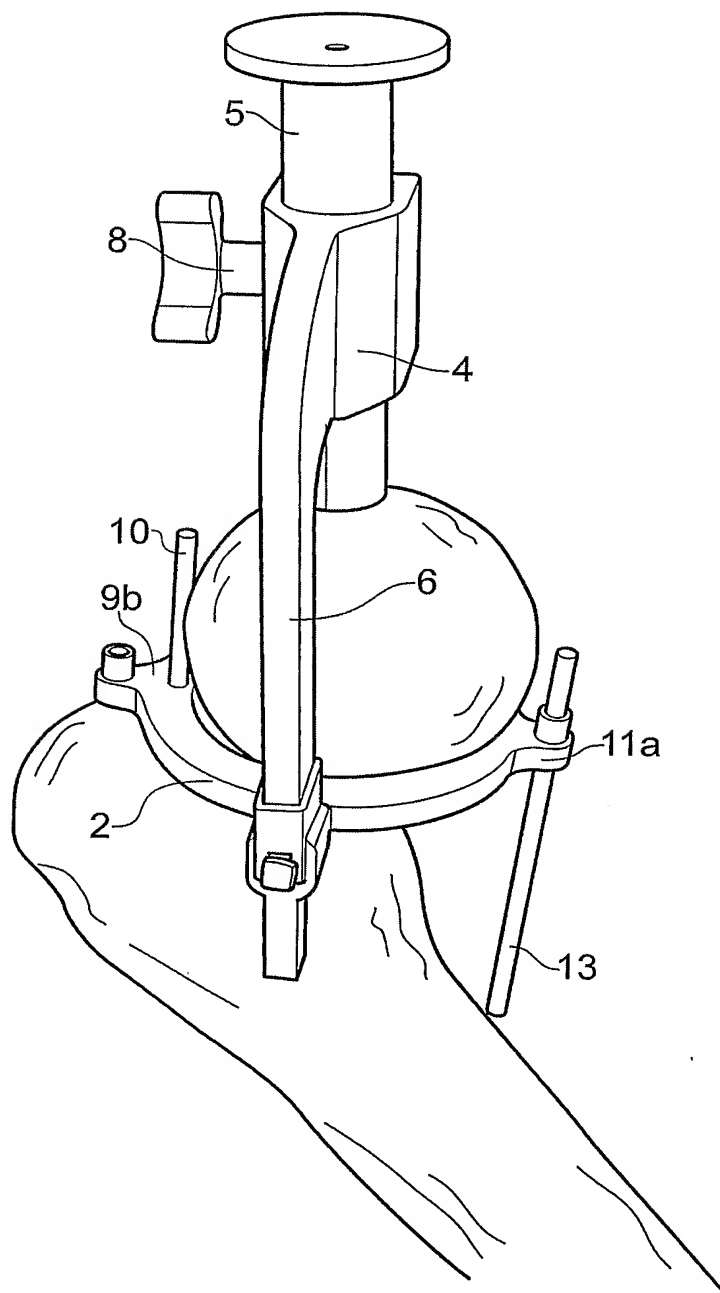


Fig. 6

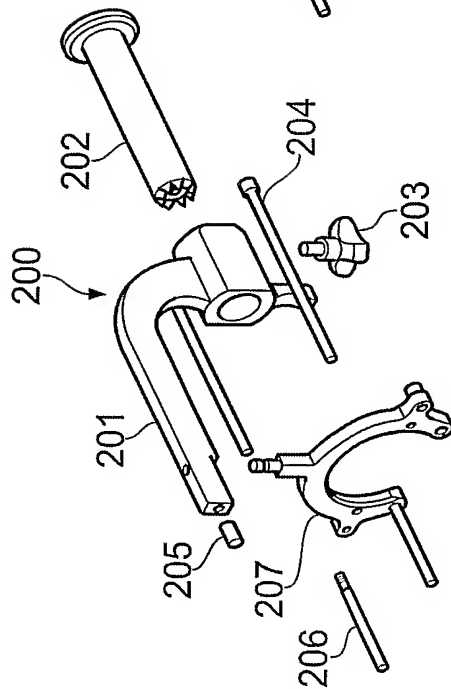


Fig. 7

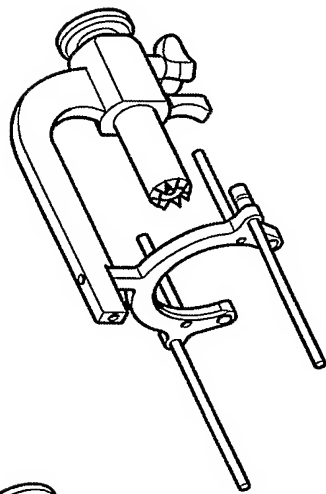


Fig. 8

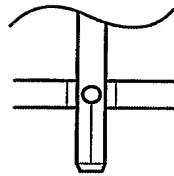


Fig. 9

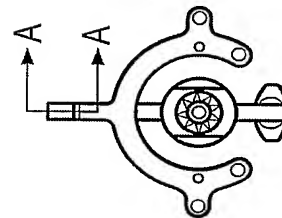


Fig. 11

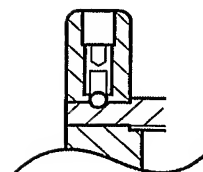


Fig. 10

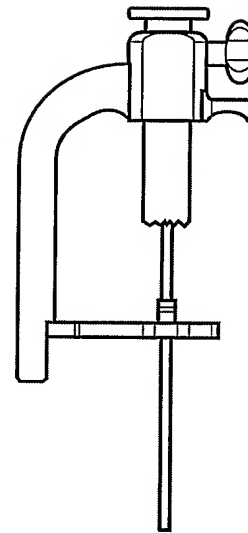


Fig. 12

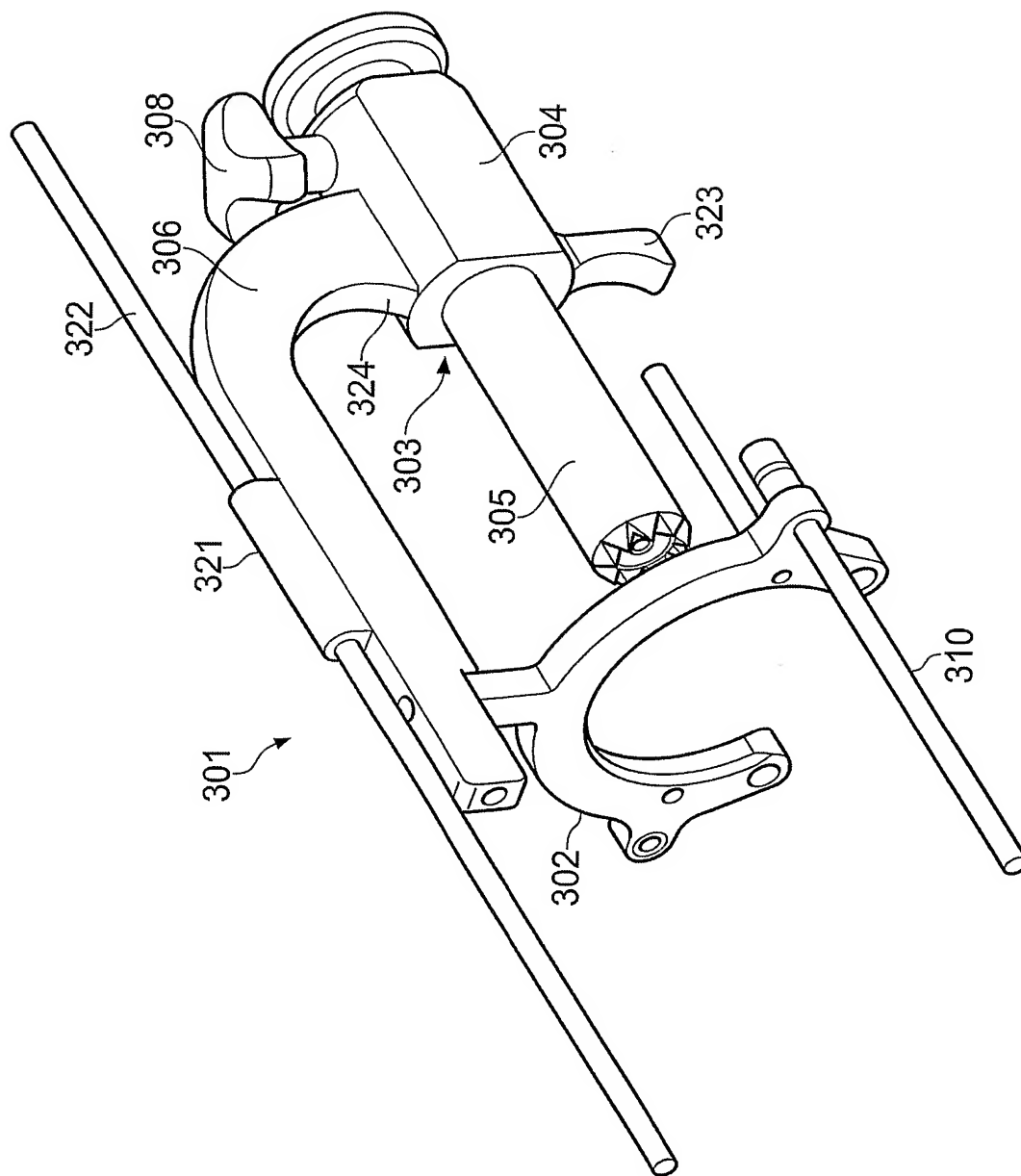


Fig. 13



# INTERNATIONAL SEARCH REPORT

International application No  
PCT/GB2006/002161

**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. A61B17/17

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/113841 A1 (SHELDON MICHAEL B ET AL) 26 May 2005 (2005-05-26) paragraph [0069]	1-15, 19, 20
X	US 6 156 069 A (AMSTUTZ ET AL) 5 December 2000 (2000-12-05) figure 9	1-12, 16
P, X	EP 1 588 668 A (FINSBURY LIMITED) 26 October 2005 (2005-10-26) the whole document	1-16, 19-21
P, X	WO 2005/112805 A (DEPUY INTERNATIONAL LTD; SIEBEL, THOMAS; O'SULLIVAN, TADGH; LINDSEY, S) 1 December 2005 (2005-12-01) figures 5, 10A, 10B	1, 2, 5-12, 15-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

\* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

Date of the actual completion of the international search

22 September 2006

Date of mailing of the international search report

10/10/2006

Name and mailing address of the ISA/  
European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Hamann, Joachim

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB2006/002161

## Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 22-29, 31  
because they relate to subject matter not required to be searched by this Authority, namely:  
Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery
2. ☒ Claims Nos.: 30, 31  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

Continuation of Box II.1

Claims Nos.: 22-29,31

Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery

-----

Continuation of Box II.2

Claims Nos.: 30,31

Rule 6.2 PCT - Reference to drawings

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2006/002161

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005113841 A1	26-05-2005	NONE	
US 6156069 A	05-12-2000	NONE	
EP 1588668 A	26-10-2005	US 2005245934 A1	03-11-2005
WO 2005112805 A	01-12-2005	NONE	